MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

EBT3036 – MEDICAL IMAGING

(BE)

14 OCTOBER 2017
9.00 am – 11.00 am
(2 Hours)

INSTRUCTION TO STUDENT

1. This Question Paper consists of 3 pages with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

QUESTION 1

a) Radiation can be divided into two broad categories based on their interaction with matter.

i) Name the two categories of radiation. [2 marks]

ii) Two examples of each category of radiation. [4 marks]

iii) One harmful effect of each category of radiation. [4 marks]

b) In radiation shielding, what is meant by the term half-value layer (HVL)? [2 marks]

c) To reduce the intensity of 200 keV gamma-rays, aluminium (Al) shielding is provided. Answer the following questions based on this shielding and energy:

i) Given that the HVL of Al is 2.14 cm, find its linear attenuation coefficient, μ. [6 marks]

ii) What is the thickness of aluminium required to reduce the intensity to 10% of the incident intensity, I_0 ? [7 marks]

QUESTION 2

The source of X-rays used in diagnostic radiography is generally a Coolidge tube.

a) What are the three requirements of a Coolidge tube for the production of X-rays? [6 marks]

b) Sketch a diagram showing the structure of a Coolidge tube and explain how X-rays are produced. [10 marks]

c) List the preferred type and characteristics of the target material at the anode of the Coolidge tube. [6 marks]

d) List three clinical applications of X-rays. [3 marks]

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QUESTION 3

Answer the following questions pertaining to magnetic resonance imaging:

a) When placed in an external magnetic field (B_o) of 3 Tesla, nuclei of atoms in tissue begin to precess at the Larmor frequency. What is the Larmor Frequency for hydrogen?

[4 marks]

b) What is an RF pulse that is used during MRI? [2 marks]

c) Explain what happens when an RF pulse is applied at the Larmor frequency.

[3 marks]

d) Explain how the MR signal is detected when the RF pulse is turned off. [3 marks]

e) Name the physical principle that generates an electrical signal in the detection coils.

[2 marks]

f) What is meant by T1 relaxation time? [1 mark]

g) When a sample is in equilibrium with the B_0 in the +z direction, we apply an RF pulse to a sample of protons. What should the strength of the RF pulse be if we need to tip the magnetization vector M into the x-y plane in 2 ms? [10 Marks]

Given : Gyromagnetic Ration for hydrogen, γ , is 42.576 MHz/T.

QUESTION 4

a) Provide one advantage and one disadvantage of optical imaging compared to X-ray radiography. [4 Marks]

b) Provide five reasons for using optical imaging of biological tissue. [10 Marks]

c) List five possible types of interactions between light and tissue. [5 Marks]

d) One application of light in medicine is photodynamic therapy (PDT), which is used to treat cancers. In photodynamic therapy two ingredients that are non-toxic on their own, a photosensitizer and light, combine in the presence of oxygen to kill cancer cells. List the procedure in a typical photodynamic therapy session.

[6 Marks]

End of Paper